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Monetary and Fiscal Policy in Portugal Before and After the Euro Adoption: An
SVAR Analysis

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Abstract

This study tried to discriminate the different impacts that fiscal and monetary decisions had on the Portuguese economy for the past two decades. Using different identification techniques and a VAR with time-varying coefficients, our main conclusions are: 1) fiscal multipliers became stronger with the adherence to the monetary union; 2) the ECB is, in general, committed to a Taylor rule type of monetary decisions that fits well the Portuguese data; 3) interest rates responded more strongly to inflation movements before the financial crisis, more strongly to unemployment movements during 2009 and less strongly to both in more recent times.

Keywords: monetary policy, fiscal policy, euro area, time-varying coefficients.

1. Introduction

The effects that the recent financial crisis brought on the GDP growth trend were especially harsh for the Euro area. Since the launch of the Euro in 1999, and full adoption at the beginning of 2002, GDP growth today is far below the trend that presented before the crisis of 2009. In the aftermath of these events, discussion on whether the fiscal consolidation that most Euro area countries took was appropriate to deal with sustainability issues due to its impact on economic growth became a central topic in media and empirical studies.

Portugal was one of the European countries where fiscal consolidation was mostly felt after 2009 and still is today. The country's real GDP took almost eight years to recover to the same level of the end of 2009, reaching it only at the beginning of 2017. But apart from the recent recession, did the country gain by adhering to the Euro in 2002? From the first quarter of 1995 until the end of 2001, the country's real GDP grew nearly 28%, growing an average of 0,92% each quarter. From the beginning of 2002 until the end of 2017, it grew less than 5%, which

represents a modest quarterly average growth of 0,08%. Monthly inflation, in the first subsample, was on average 0,24%. After adopting the Euro, it was on average 0,15%. It seems that Portugal gained some ability to stabilize prices growth, but on the other hand accomplished much shier real GDP growth rates. It gets even more interesting to see that the quarterly average real government spending between 2002 and 2017 was 34,9% higher than the average between 1995 and the end of 2001.

It makes sense to ask if losing interest and exchange rate decisions independence was a wise choice, but it is not possible to answer that question without knowing what changed. In particular, one should ask how and why the economic responses to fiscal and monetary shocks changed (or why did they not) during the last decades. To analyze this, we will both use a simple framework with vector autoregressive models, where we will employ and compare the results from different identification techniques, and a more sophisticated approach using a VAR with time-varying parameters (this last one will focus especially on monetary policy) which is estimated using Bayesian techniques. This last methodology will be particularly helpful to study to which degree monetary authorities respond to inflation or unemployment or rather to other variables throughout the ECB era and how is the transmission mechanism of their decisions to the Portuguese economy evolving.

Making use of these techniques, we reached some interesting conclusions: in the last twenty-two years, fiscal expansions have positive and persistent impacts on real output and, depending on the technique employed, we find some puzzling reactions of prices to interest rates movements. However, when we split the sample and analyze the changes after the Euro adoption, we find that fiscal multipliers are much stronger after 2002. Also, we find that ECB is performing decisions that fit almost perfectly a Taylor rule framework for the Portuguese data, except for the beginning of the financial crisis. Lastly, it seems that the ECB is becoming

a little softer in responding, via interest rates, both to inflation and unemployment in more recent periods.

These conclusions contribute to the literature by providing a very good picture of what both Portuguese and European policy makers should consider when making their decisions: fiscal consolidations have a severe impact in real GDP in more recent years, something that the government should have in mind may another recession take place in the near future. They also raise some questions on how we think about monetary policy transmission mechanism in a monetary union. Because the ECB responds to combined data of nineteen countries, the way that one single country responds to those decisions might not be as straightforward as one may think, a reality that should be taken into consideration by the authorities.

The rest of the document is organized in the following way: section two contains a brief literature review on the subject and also on the methodology; section three explains the methodologies employed and presents the selected data; in section four we briefly discuss the main results and section five concludes the work.

2. Literature review

There is a vast literature that studies this issue, in particular that tries to analyze whether countries fiscal policy' stability and sustainability has been affected by the adoption of the Euro. Karras (2015), Fatás and Mihov (2008) and Galí and Perotti (2003) studied the different impacts that joining the Euro had in countries' fiscal rules. The first concludes that in general fiscal policy has been countercyclical and sustainable, the second argues that it did not bring significant changes in countries' fiscal rules and that national policies are mainly procyclical, and the last one argues that fiscal tools did not lose any stabilization power.

However, to quantify the impact that fiscal and monetary shocks have on output most of the literature uses VAR models. Interpretations of VAR models require identifying assumptions that should be based on institutional knowledge or economic theory. The identification

strategies mostly used in literature are the sign restriction approach and the recursive approach. One common recursive approach used is the Cholesky decomposition. Perroti (2005) synthesizes well the advantages and disadvantages of the abovementioned approaches. Perotti (2005) constructs a structural VAR to quantify the effects of fiscal policy shocks on macroeconomic variables such as GDP, inflation and interest rates in five OECD countries. The conclusions are that: fiscal policy effects on GDP are small, tax cuts do not work faster or better than increasing government spending, the effects of fiscal stimulus are becoming weaker over time and government spending has small effects on inflation.

Mountford and Uhlig (2009) also analyze the effects of fiscal policy shocks using sign restrictions on the impulse responses. Using US quarterly data from 1955 until 2000, the authors found that deficit-financed tax cuts are able to produce a fiscal multiplier such that the present value of one additional dollar spent turns into additional five dollars five years after the shock. On the other hand, Fatás and Mihov (2001) rely their identification strategy on a Cholesky ordering of the variables. The order that the authors impose are such that government spending does not respond automatically to GDP changes. The study uses quarterly data for the variables private output, GDP deflator, real three months T-bill, real government spending, and taxes net of transfers from 1960 until 1996 for the US and compares the results from the VAR with some theoretical variations of the real business cycle theory. They found that positive shocks in government spending increase both consumption and employment in a permanent way.

The first model of our essay will use both identification strategies. As in the abovementioned literature, it will have the main focus of quantifying the fiscal multipliers for the past two decades in the Portuguese economy, analyze its impact on prices, and see how the economy reacts to interest rates movements. We will be able to check in which type of conclusions from the abovementioned studies does ours include.

Focusing particularly in monetary policy issues for the US economy from 1953 until 2001, Primiceri (2005) uses a VAR with time varying coefficients employing Bayesian techniques. This technique allows to distinguish between changes in the size of the exogenous shocks throughout time and changes in the way these shocks spread through the economy. With this technique, he was capable of capturing in which period were authorities responding more or less to inflation and/or unemployment or rather to other variables, and also how did the transmission of monetary policy evolved during the studied years. The conclusion is that the period between 1979 and 1983 was very unusual but that the propagation of interest rates shocks into the economy did not change much. We will see that, with similar methods employed, our conclusions for the Portuguese economy are quite alike.

From a theoretical point of view, Abreu (2005) analyses the monetary policy framework in Portugal between the end of the Bretton Woods system and the adoption of the Euro and finds very distinctive periods where the monetary and foreign exchange policies were highly accommodative for large deficits that translated in high inflation periods and other decades where those policies became highly committed to fight inflation by anchoring the expectations of the different agents and restoring *Banco de Portugal*' credibility. Our study, with the special focus in the monetary policy decisions particularly after the fully adoption of the Euro, provides some sort of extension to Abreu (2005).

3. Methodology and data

VAR models that were introduced by Sims (1980) have become the main econometric tool to quantify the effects of monetary and fiscal shocks in different economies. This study will also make use of this methodology. To answer to the main questions of the study, we conducted two different approaches: first, we constructed a simple benchmark VAR to analyze the monetary and fiscal transmission mechanism in the past twenty-two years and then, to capture possible structural changes in the economy with the fully adoption of the Euro, we split the sample in

two. Then, a more complex but presumably more rigorous technique is performed to study the monetary policy decisions and their impact in Portugal: a Bayesian VAR with time varying parameters.

The variables included in our first model (benchmark VAR and sample split) are the log of real GDP, the log of consumer price index (CPI), the log of nominal government spending (current expenditure) and short-term interest rates. The CPI used is an average of the monthly CPI's of each quarter. Short term interest rates are the three-month interest rates at the money market and are taken from OECD data. CPI and real GDP are taken from Statistics Portugal and government spending from Portuguese debt management department.

3.1 Benchmark

Our benchmark VAR, which uses all the sample from the beginning of 1995 until the end of 2017, will be used to compare the results with the other two techniques. It has the following reduced form representation:

$$Y_t = C_t + B(L)Y_{t-1} + u_t \quad (1)$$

where Y_t is a vector of the above-mentioned variables and C_t is a vector with constants. Two lags are used according to the Schwarz information criteria.

Regarding the identification technique to simulate the responses to the shocks, we will both use a Cholesky decomposition and a sign restriction approach since both present advantages and disadvantages. Using both techniques will allow us to access if they yield similar results which will make our conclusions more robust. Regarding the first strategy, the order of the variables in the VAR is the following: Real GDP, average CPI, short-term interest rates and government expenditure. This means that real GDP is not contemporaneously affected by monetary policy changes (here, measured by shocks in the short-term interest rates) nor government expenditure or the price level of the economy. By doing so, we are saying that the real activity of the

economy only responds to fiscal stimulus one period later. On the other hand, we are implicitly imposing that the level that the government spends is a function of the macroeconomic variables at that same period. Also, ordering interest rates and government expenditure (the two shocks we are interested in) last isolates them properly to better analyze the impact on the other variables. Figure 1(a) shows the impulse response functions of the real GDP and the average CPI to a one-standard-deviation shock both in fiscal and monetary policy variables.

The other strategy (sign restriction imposed upon the response functions) uses a rejection method and it can be well defined in a Bayesian framework. We follow Uhlig (2005) and use priors that put zero weight on some set of impulse responses. In this way, the posterior response functions will be the ones that respect the restrictions. Succinctly, the strategy consists in drawing n_1 posteriors for $B(L)$ and Σ (variance-covariance matrix) using a conjugate prior normal inverted-Wishart on both parameters that guarantees that the posterior is normal distributed. In each draw, one uses a Cholesky decomposition to orthogonalize the shocks. Then, we do n_2 draws on the impulse vectors and calculate the impulse response functions. The methodology consists in only keeping the responses that respected the sign restrictions. Our restrictions on the impulse response functions are so that a contractionary monetary policy shock (increasing interest rates) induces a negative response of CPI for two periods, while a fiscal policy shock (increasing government expenditure) induces a positive impact on output also for two periods. The first restriction goes along with nowadays central bank's policies, and also ECB, which uses policy interest rates to influence the price levels of the economy. If it increases interest rates, the central bank is trying to activate a mechanism through which it cools down consumption and investment and therefore prices. On the other hand, the sign restriction imposed to fiscal shocks imply that it stimulates the economy in a way that creates real GDP growth but only for two periods, meaning that we do not rule out any possible crowding-out effect after a semester. The choice of two periods for the impulse constrain is in line with Uhlig

(2005), except that he imposes for five months the restrictions, and we impose for six months (since our data for this methodology has a quarterly frequency). The IRF's for the benchmark VAR with sign restriction imposed on the responses are displayed in Figure 1(b) and 1(c) for fiscal and monetary shocks, respectively.

3.2 Sample Split

In this strategy, we split the benchmark VAR in two sub-samples, being them 1995Q1-2001Q4 and 2002Q1-2017Q4 and re-estimate a VAR for each of the subsamples. The choice of 2002 as the starting year for the Euro is because it was the year in which Euro notes and coins start to circulate, despite early virtual adoption at the beginning of 1999. This is an attempt to capture the time variation in parameters that the Euro currency adoption may have induced in the Portuguese economy. Both samples have the same variables as the benchmark VAR. Two lags are also used in both sub-samples to be consisting with the ones used in the first methodology. Again, the same two identification techniques are studied and compared. Figure 2(a) and 3(a) show the responses of real GDP and CPI to monetary and fiscal shocks using a Cholesky identification for both sub-samples. Figures 2(b) and (c) show the impulse responses of real GDP and CPI to fiscal and monetary shocks for the first subsample and figures 3(b) and (c) show the impulse responses of real GDP and CPI for both fiscal and monetary shocks using the sign restriction for the second subsample. The sign restrictions on the impulse responses are equivalent to the ones that were previously described in section 3.1.

3.3 Bayesian Time-Varying VAR

To capture smooth transactions both between the size of the reactions to exogenous shocks and to changes in the transmission mechanism throughout the economy, a VAR with time-varying parameters following Primiceri (2005) and Del Negro and Primiceri (2014) was estimated to study the monetary policy framework in which the ECB operates and how does the Portuguese

economy respond to it. It is particularly interesting to analyze what was, at some particular points in time, the level of reactiveness that monetary policy authorities presented to inflation or unemployment, the two variables associated with the trade-off monetary authorities face. We will also see if the mechanism through which interest rates impact inflation and unemployment has changed in the past twenty years. To this exercise, we use monthly data from 1998M2 until 2018M6. Without going in too much detail and in a general way, the model can be described as it follows:

$$y_t = c_t + B_{1,t} y_{t-1} + \dots + B_{k,t} y_{t-k} + u_t \quad t = 1, \dots, T \quad (2)$$

where y_t is a vector that contains the variables monthly inflation, unemployment and interest rates, c_t is a vector of constants that are multiplying by time varying coefficients, $B_{i,t}$ (where $i = 1, \dots, k$) are $n \times n$ matrices (in our case, 3×3) of time varying coefficients; u_t are unobservable shocks and Ω_t is the variance covariance matrix of those shocks. It can be defined that

$$A_t \Omega_t A_t' = \Sigma_t \Sigma_t' \quad (3)$$

where

$$A_t = \begin{bmatrix} 1 & 0 & \dots & 0 \\ \alpha_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{n1,t} & \dots & \alpha_{nn-1,t} & 1 \end{bmatrix} \text{ and } \Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \dots & 0 \\ 0 & \sigma_{2,t} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \dots & 0 & \sigma_{n,t} \end{bmatrix}$$

Expression (2) can then be re-written as

$$y_t = c_t + B_{1,t} y_{t-1} + \dots + B_{k,t} y_{t-k} + A_t^{-1} \Sigma_t \varepsilon_t \quad (4)$$

$$V(\varepsilon_t) = I_n \quad (=)$$

$$(=) \quad y_t = X_t' B_t + A_t^{-1} \Sigma_t \varepsilon_t \quad (5)$$

$$X_t' = I_n \otimes [1, y_{t-1}', \dots, y_{t-k}']$$

where \otimes stands for the Kronecker product. The driving processes of the system are:

$$B_t = B_{t-1} + \tau_t \quad (6)$$

$$\alpha_t = \alpha_{t-1} + \gamma_t \quad (7)$$

$$\log \sigma_t = \log \sigma_{t-1} + \theta_t \quad (8)$$

This means that the elements of the vector B_t and A_t (the ones that are allowed to be different than zero or one) follow a random walk, while the standard deviation σ_t follows a geometric random walk. The innovations of the model have the following assumptions:

$$V = Var \left(\begin{bmatrix} \varepsilon_t \\ \tau_t \\ \gamma_t \\ \theta_t \end{bmatrix} \right) = \begin{bmatrix} I_n & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & W \end{bmatrix} \quad (9)$$

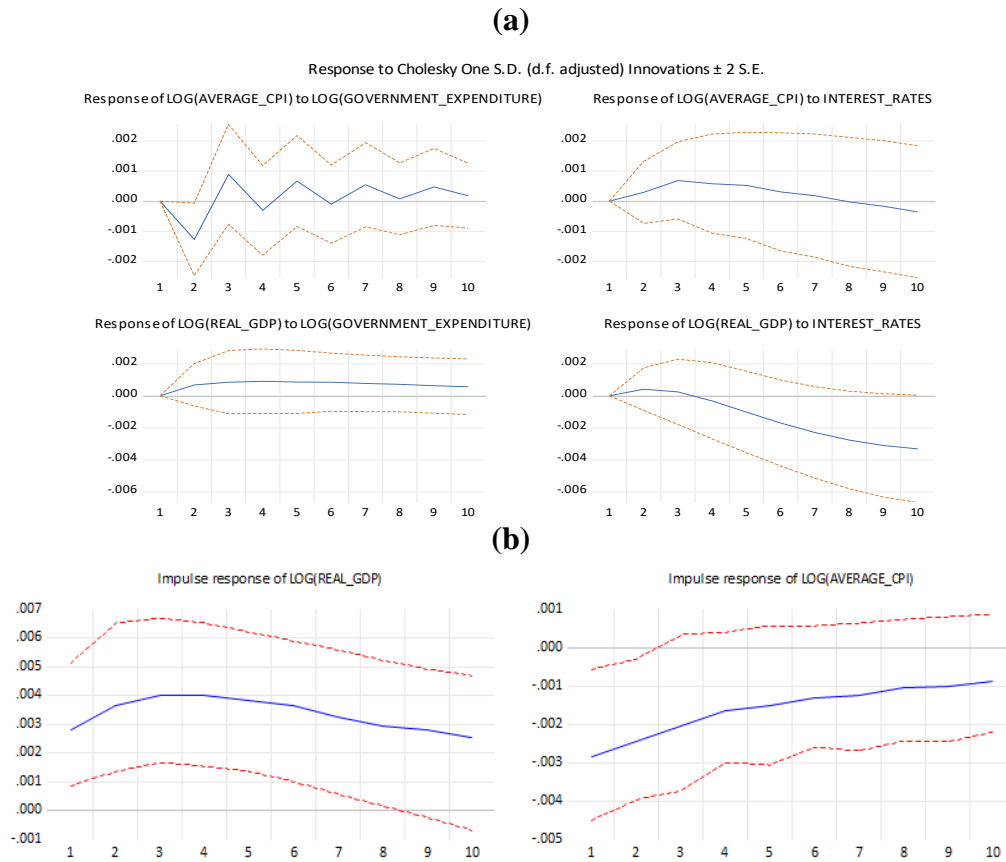
However, the restrictions on V are not essential and can be relaxed. Nevertheless, they are convenient especially because a more generic correlation structure among the variables would possibly prevent any plausible interpretation of the shocks. See Primiceri (2005) for a more detailed discussion on this.

The methods used to estimate the posterior distributions of all the parameters and hyperparameters of the variance covariance V matrix are Bayesian techniques. Particularly, Gibbs sampling is used to generate the posterior of the parameters of interest, which is a particular method within Markov chain Monte Carlo (MCMC) methods. Priors for the hyperparameters are assumed to be independent inverse-Wishart distributed, while priors for the coefficients on B_0 , simultaneous relations α_0 and standard errors σ_0 in logs are assumed to be normally distributed. Again, this assumptions are in line with Primiceri (2005). The prior distributions are then constructed using the first forty observations of sample. Two lags are used in the model specification and the identification assumption is that interest rates do not affect contemporaneously neither inflation nor unemployment which is meant to isolate shocks in interest rates, the variable of interest for monetary policy decisions.

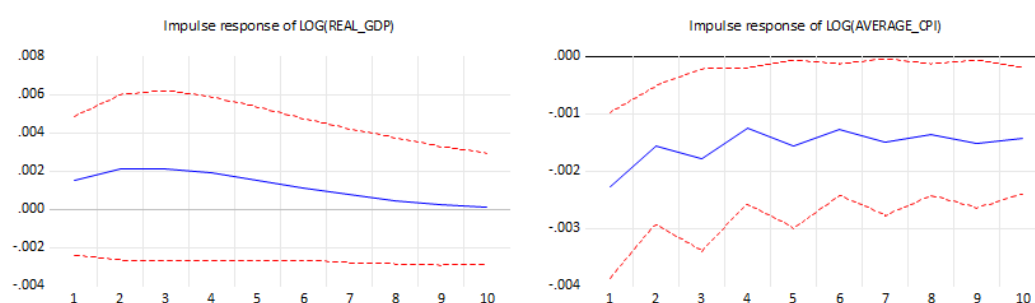
4. Results

First, we examine the results for the benchmark VAR. Fiscal expansions clearly produce positive effects on output, something that both the Cholesky decomposition and the sign restriction yields, however with the sign restriction the response of output is almost twice as large as for the Cholesky decomposition. The way prices respond to this shock, and also the way prices and real output respond to contractionary monetary policy decisions (interest rates positive shock) differ substantially in direction and size with the identification strategy. This raises some questions and one is tempted to admit that the techniques which yield more commonly accepted responses are the ones where the shocks are more properly specified. However, as we will see, the time-varying VAR also delivers a clear price puzzle.

Figure 1: Impulse response functions of benchmark VAR: (a) Cholesky; (b) fiscal policy shocks with sign restriction; (c) monetary policy shocks with sign restriction.



(c)



Since we are also interested in the time variation that the introduction of the Euro may have introduced, we will compare which identification strategy yields more plausible results in both subsamples in the case that they provide different impulse responses within the same subsample. If both strategies yield similar responses to the same shocks, conclusions become more robust and can be drawn about the dynamics of the economy and the changes before and after the beginning of 2002.

1995Q1-2001Q4 VAR: A fiscal shock creates inflationary pressures, although in different proportions, for both Cholesky and sign restriction approaches. The impact on real GDP is always positive but almost insignificant for the Cholesky decomposition, whilst with the sign restriction is positive for five quarters and then it becomes negative or close to zero. The conclusion might be that before the Euro, fiscal stimulus did not produce great effect on output or the positive effect that produced was crowded-out some quarters later. As we will see, there is evidence that fiscal multipliers were bigger in the second subsample, for both Cholesky and sign restriction approach. Fiscal expansions are, presumably, actions that pressure the price level of the economy, since they represent a wealth transfer to the agents that gain more purchasing power (bear in mind that we use current expenditure, excluding capital expenditure). Then, it lays on central banks' framework to prevent that such expansions put demand driven pressure on prices such that inflation soars. So, another interpretation can arise: before the Euro,

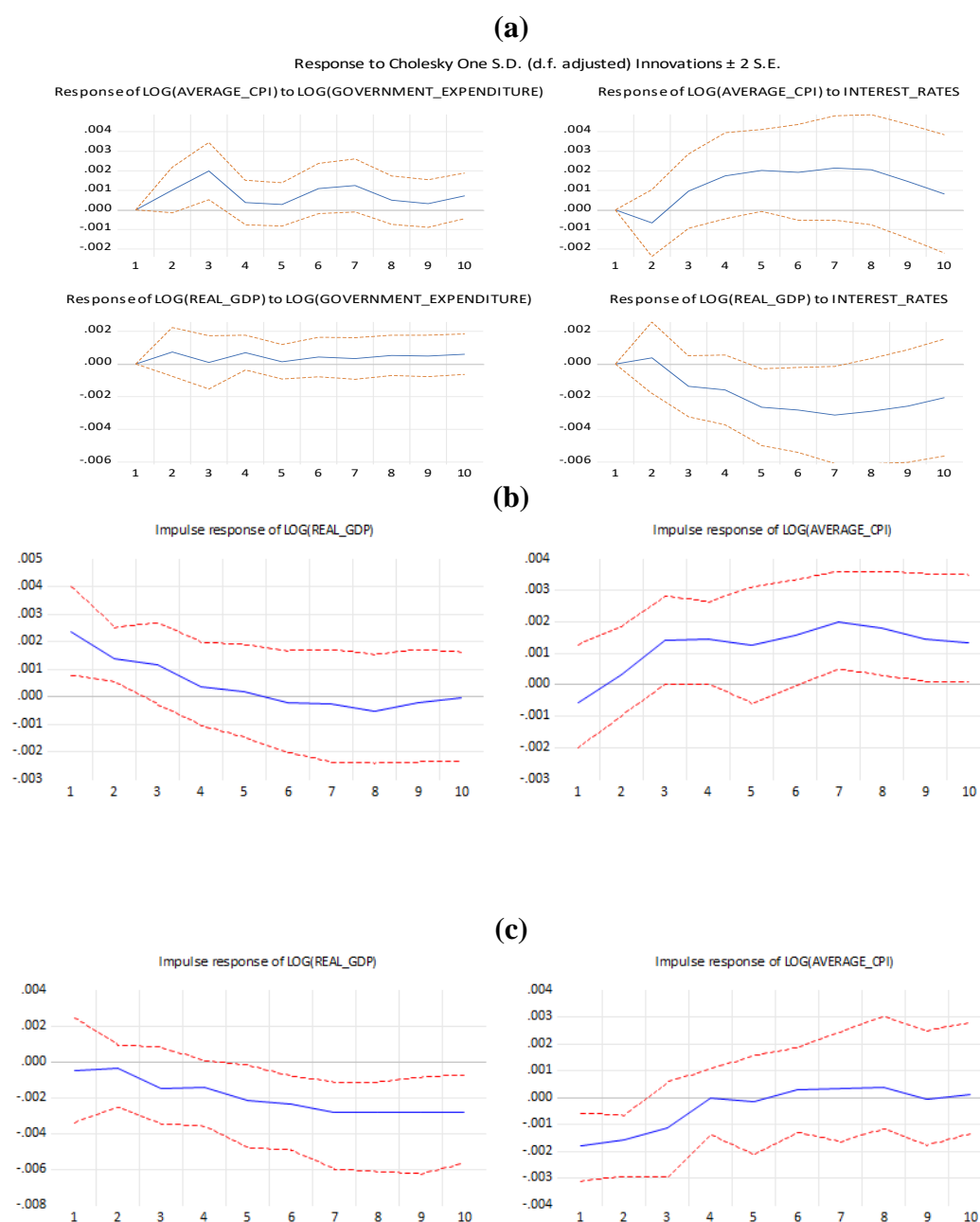
Portuguese monetary authorities were not able to properly accommodate fiscal expansions, therefore fiscal expansions pressured prices to increase.

Considering the interest rates shock, the impact on CPI differs considerably with the identification strategy used. With the Cholesky decomposition, a positive shock in interest rates makes consumer prices to increase considerably after the second period, while in the sign restriction strategy the CPI responds negatively for four quarters, and then it becomes slightly positive or null for the rest of the periods. Several studies report this puzzling reaction of prices that the Cholesky decomposition presents, arguing that it might be the supply side of the economy working: higher interest rates increase the cost for firms to get (or repay) loans and therefore forces them to increase prices. See Barth III and Ramey (2002) for a more detailed discussion on this. However, the sign restriction approach yields a more commonly accepted response where prices decrease with increasing interest rates. Real GDP also responds negatively to interest rate shocks for both Cholesky decomposition and sign restriction, so both techniques seem to capture well the fall in consumption and investment that this shock imposes on the economy (despite a first positive impact for one period when considering the Cholesky approach) provided it successfully transmits to the lending interest rates of the economy. There is perhaps also another reason for prices to respond negatively for some periods and thereafter positively: an increase in interest rates makes investment and consumption to decrease, decreasing both output and prices. This decrease in consumption and investment, after some periods, starts to affect not only the demand side of the economy but also the supply side starts to be affected. If the supply side starts to contract, there is an opposite pressure on prices to increase. This might be the mechanism that makes prices to shift from negative to positive responses after four quarters (for the sign restriction approach).

All in all, both strategies yield positive, but relatively small effects of fiscal expansions on output and also on prices. It is also clear that a contractionary monetary policy decision

contracted output as both identification strategies present this result. However, prices respond in a slightly different way for each strategy. We are tempted to conclude that the sign restriction approach yields more plausible responses since prices decrease after an increase in interest rates and this does not happen with the Cholesky decomposition.

Figure 2: Impulse response functions of 1995Q1-2001Q4 sample: (a) Cholesky; (b) fiscal shocks with sign restriction; (c) monetary shocks with sign restriction



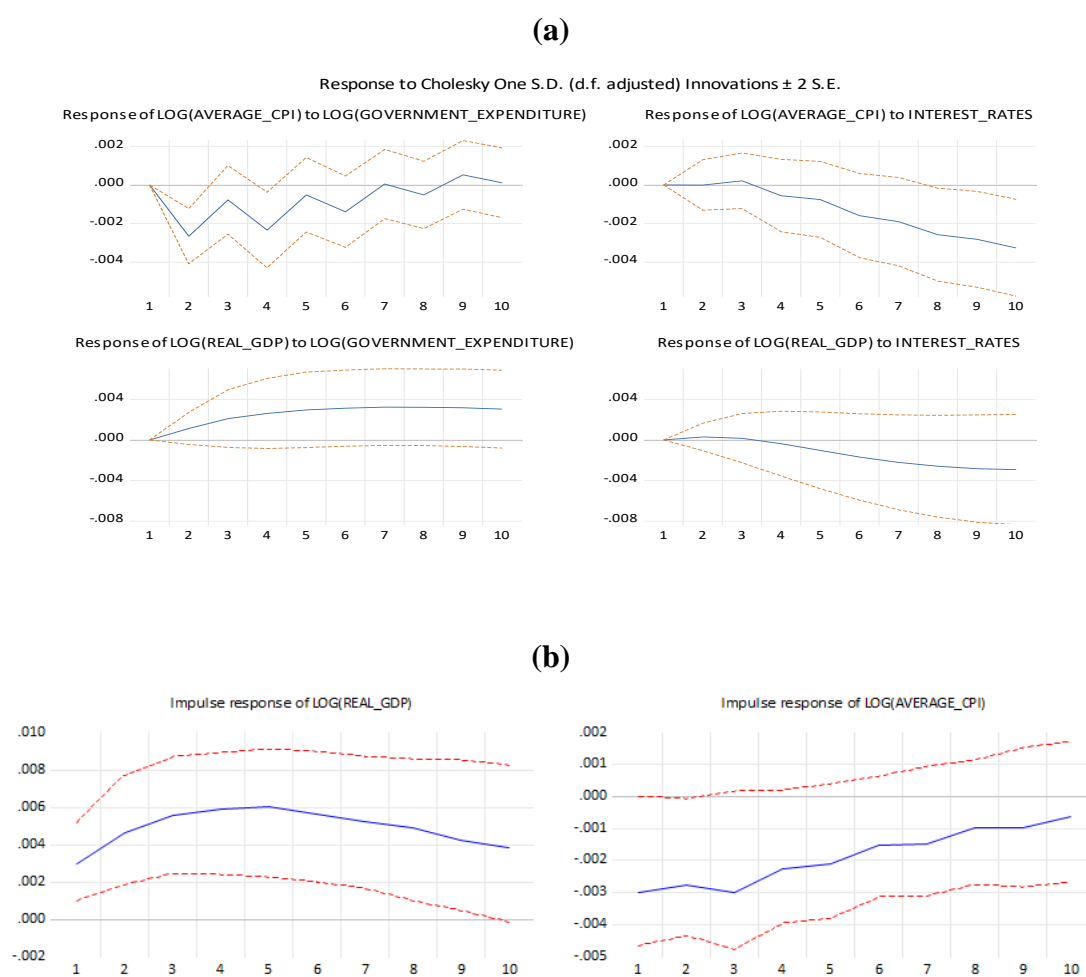
2002Q1-2017Q4: Fiscal shocks yield similar responses both in real GDP and consumer prices for both identification strategies. Real GDP responds positively while prices have a negative reaction. The responses show a higher fiscal multiplier in more recent times, perhaps because the second subsample contemplates the recent financial crisis and there is some empirical evidence that in recessions fiscal multipliers gain more power (Auerbach and Gorodnichenko (2013)). It might also be evidence that *Banco de Portugal* (as the majority of the central banks) probably crowded-out government spending by increasing interest-rates in order to prevent inflation before 2002 which impacted investment and consumption. With the adherence to the monetary union, this direct reaction of the central bank lost effect, since ECB does not increase benchmark interest rates for all the monetary union in response to Portuguese government expenditure. This might be a crowding-out effect that was felt before the Euro, but lost effect after, therefore contributing to the increased fiscal multiplier.

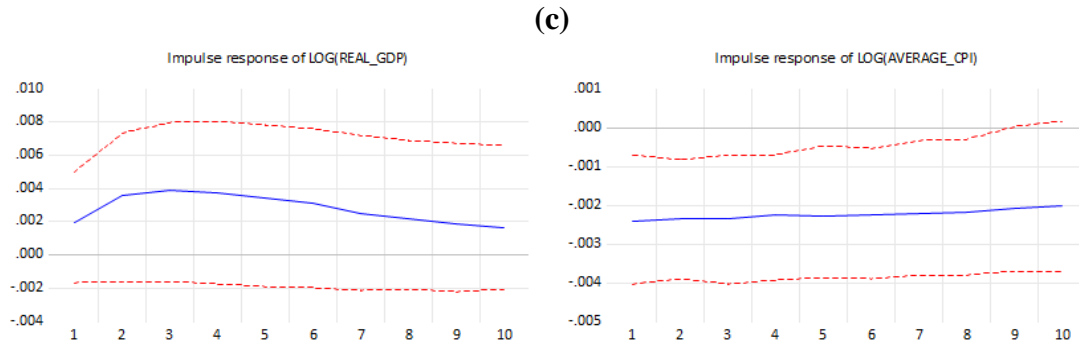
At the same time, although it is not possible in this framework to understand exactly how, fiscal expansions became deflationary. Since we specified our model in other two different ways - one using core CPI instead of total CPI, in order for prices to mainly change with changes in the demand side of the economy, and other specification including industrial production to capture any possible disturbances in the supply side of the economy - and the results did not change significantly, it is possible that the structure of the fiscal expansions itself changed with the adoption of the Euro, and that therefore the response of prices changed (one example could be that those fiscal expansions started to be directed to productive subsidies allowing companies to decrease prices). However, this is beyond the scope of this study.

Monetary shocks decrease both prices and real GDP when we consider the Cholesky decomposition but increase real GDP when we use a sign restriction on the impulse responses. Summarizing, after the Euro both Cholesky decomposition and sign restriction tell us that fiscal multipliers increased and that fiscal expansions decreased prices. Also, it seems that monetary

policy became more efficient in controlling prices. This can be interpreted as a more effective monetary policy transmission mechanism in the monetary union than before and is another evidence of the structural changes created by the monetary union. However, the sign restriction approach shows a positive response of GDP to an interest rate increase, so it seems that the Cholesky decomposition captures more properly this impact.

Figure 3: Impulse response functions of 2002Q1-2017Q4 sample: (a) Cholesky; (b) fiscal shocks with sign restriction; (c) monetary shocks with sign restriction





In conclusion, fiscal multipliers are larger after the adherence to the Euro zone - nearly doubled in both identification strategies and stopped being crowded-out in our response horizon when we consider the sign restriction - and the transmission mechanism of monetary policy seems more efficient in recent years, with interest rates hikes decreasing prices. As explained above, we also specified the model using core CPI instead of normal CPI and also including industrial production index. In both cases, the results did not change.

Table 1: Resume of all the directions and sizes of the impulse responses of real GDP and CPI using different identification techniques for the sample split approach

		Cholesky		Sign Restriction	
		Real GDP	CPI	Real GDP	CPI
<i>1995Q1-2001Q4</i>	Fiscal shock	+	+	+/-	+
	Monetary shock	-	+	-	-/0
<i>2002Q1-2017Q4</i>	Fiscal shock	++	-	++	-
	Monetary shock	-	-	+	-

Concerning the time-varying VAR, the first analysis is to study if ECB monetary policy decisions fit the Portuguese data in a sense that they respond to Portuguese inflation and unemployment or rather to other variables. This can be captured by the posterior mean of the standard deviation of the interest rate residuals equation (Figure 4 (a)). This graph elucidates that ECB makes monetary policy decisions in a way that they respond well to Portuguese inflation and unemployment. In other words, it seems that they are committed to a Taylor rule

type of policy, where they respond to rather inflation or unemployment, and that decisions seem to be adequate for Portugal. However, there are two periods where this was not true: before 2003 and at the beginning of the financial crisis, namely 2008 and 2009.

Figure 4: Posterior mean of the residuals with the 16th and 84th percentiles of the standard deviation. (a) Interest rate; (b) Inflation; (c) Unemployment

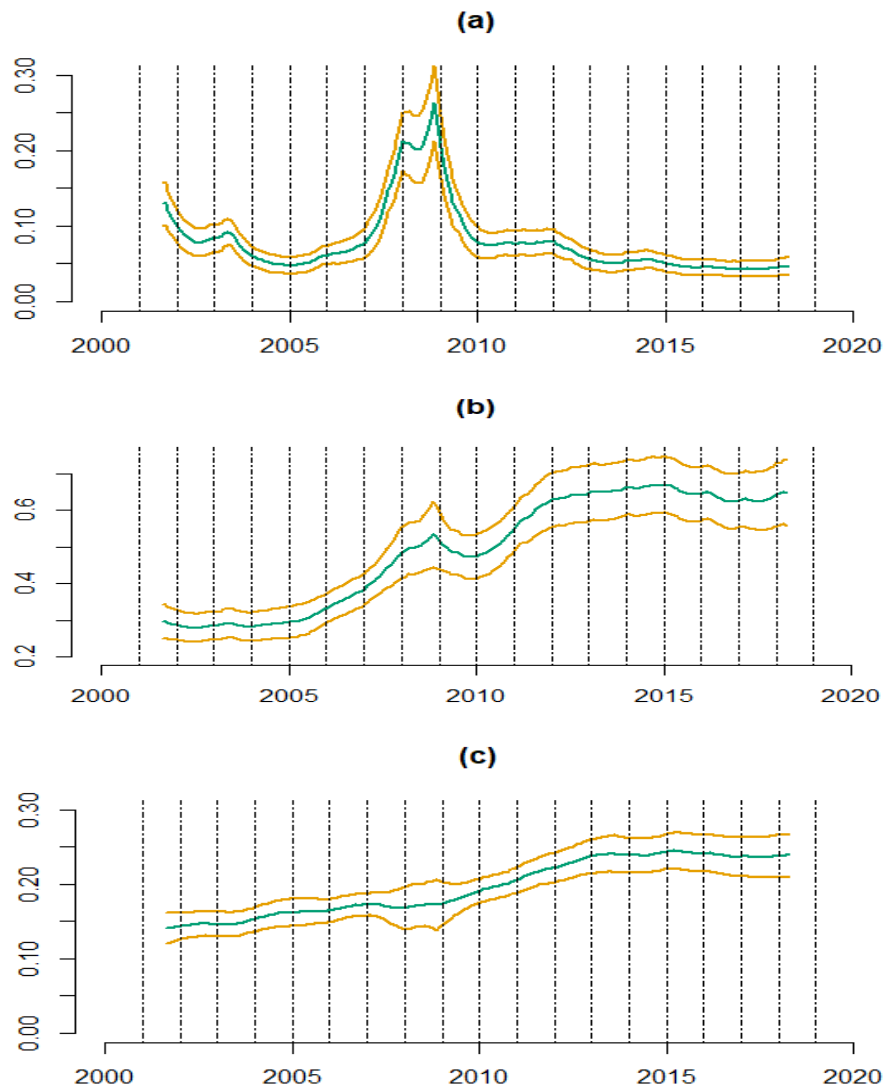
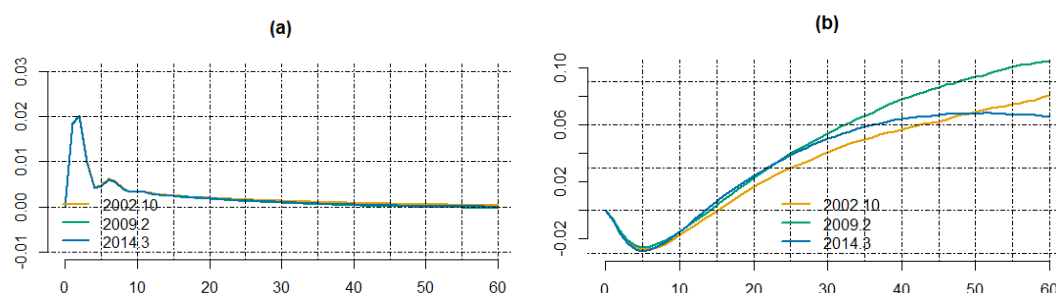


Figure 5 show the responses of inflation and unemployment in particular chosen periods to interest rate shocks, respectively. We chose three dates that correspond to a period before, at the beginning and after the financial crisis. Apart from this, the dates were arbitrarily chosen. The main conclusion is that the mechanism through which interest rates impact the economy

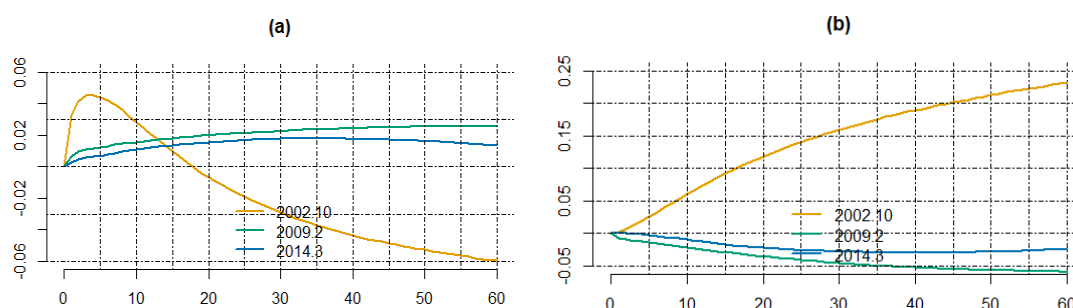
did not change much through the sample, not even in the period of the crisis. Although all the responses of unemployment are negative for some periods, they become positive afterwards, and this is in line with the same responses of Primiceri (2005) for the US economy. Also, although in small way, inflation responds positively to an increase in interest rates for the considered horizon. There is also a small price puzzle in Primiceri (2005) conclusions, although for slightly less periods. Note that this is in disagreement with the responses from the sample split VAR to interest rates shocks for the subsample after the Euro, especially. To access if this was an identification issue with our model, we re-estimated the model in two different ways: one including industrial production growth to control for any supply side effects, and other using core inflation rate instead of normal inflation rate. We also specified the model changing the order of the variables. These different specifications did not change the results. Also, note that if monetary authorities respond to increasing inflation by increasing interest rates, meaning that they act in a countercyclical way, these actions might “contaminate” the statistical evidence with the illusion that higher interest rates increase prices. So, having this possibility in mind, it becomes interesting to check what is the response of interest rates to inflation. It might also be that the increase of interest rates has a positive effect on the incomes of a certain group of agents (lenders) that are able to consume more, putting pressure on prices through the demand side of the economy. Finally, if we consider figure 4 (b), it is possible to see that the residuals of the inflation equation are the ones with the highest a more volatile values, and therefore evidencing that other variables not specified in this framework are indeed interfering with the inflation behavior, at least in our sample. Nevertheless, the main purpose of this specific exercise was to see if the mechanism through which monetary policy decisions transmit to the economy changed significantly, and it seems it did not.

Figure 5: Impulse response to interest rates shock in October 2002, February 2009 and March 2014. (a) Inflation responses; (b) Unemployment responses



Lastly, figure 6 show the responses of interest rates to inflation and unemployment shocks to the same chosen periods. This is meant to capture the reactivity of the central bank to these variables. As it is possible to see, before the financial crisis, interest rates respond much sharply to inflation than the subsequent years. During the crisis, interest rates started to respond much more to positive shocks in unemployment. In more recent periods, when nominal interest rates started to approximate the zero rate, they became less reactive both to shocks in inflation and unemployment than they were before, one of the reasons that ECB had to embrace unconventional monetary policy instruments, such as the quantitative easing program. We also find a peculiar response of interest rates to unemployment shocks in 2002.

Figure 6: Impulse responses of interest rates in October 2002, February 2009 and March 2014. (a) Inflation shock; (b) Unemployment shock



5. Conclusion

The main purpose of this study was to analyze the monetary and fiscal policy impact in Portugal for the past two decades, and also to partially analyze to what extent did the introduction of the Euro changed the relationship among macroeconomic variables. In particular, we focused on how fiscal stimulus and contractionary monetary policies affected real GDP and consumer price level before and after the common currency. We went a little further and, focusing on monetary policy, tried to study if the European monetary authorities are following a Taylor rule in performing monetary policy decisions and if their decisions fit this rule for the Portuguese economy in the last two decades. Finally, we studied to which degree did the transmission mechanism of monetary policy shocks to inflation and Portuguese unemployment changed throughout this period and how did the degree of reactivity of interest rates to inflation or unemployment also changed.

Several methods were employed in order to reach our conclusions. First, we used a framework with a simple VAR model. For this approach, our conclusions relied on two identification methods, being them the Cholesky decomposition and the imposition of sign restrictions upon the impulse response functions. The discussion on how the results of a VAR may depend on the chosen identification technique is well known and therefore, by using both techniques and comparing them, we made our conclusions more robust. Secondly, we constructed a time-varying VAR using Bayesian techniques that allows for changes both in the coefficients and in the variance covariance matrix throughout time.

Our conclusions indicate that fiscal multipliers are considerably larger in recent times than they were before the Euro - with the Cholesky identification, they are more than twice as large; with the sign restriction approach, apart from also being much larger, fiscal expansions are not crowded-out after some periods as they were before the Euro. Although the common currency facilitates the event where fiscal expansions may be spent by consumers outside borders, we

believe that a possible shrinkage of any sort of interest rates crowding-out effects surpasses this imports effect (also because this import effect may have been a reality since 1986 with the adherence to the European Free Trade Association, for example, before the adherence to the monetary union), and therefore fiscal multipliers enlarge. Also (and perhaps as a consequence of the large fiscal multipliers in contributing to the supply side of the economy) these expansions in the Euro era tend to deflate prices, something that they were not able to do before the Euro. Our impulse response functions confirm this point of view.

The second exercise indicates that the European monetary authorities follow a Taylor rule type of monetary policy that fits the Portuguese data. Of course, ECB is/was not (only) directly responding to Portuguese data, so this can be seen as if our economy is/was a good picture of the type of macroeconomic conditions that the Euro area faced through the sample and therefore in which ECB based their decisions. However, at the beginning of the financial crisis this relation seems to brake, being restored a few periods later. We also analyze the responses of inflation and unemployment to interest rate shocks and conclude that it did not change significantly throughout the sample. Interestingly, with this methodology, we find a clear price puzzle response of inflation to interest rates in the Portuguese economy, although it disappears after some periods. Unemployment has a similar behavior, although in the opposite direction. These behaviors are also found in Primiceri (2005) for the US economy.

Finally, to further study the reactiveness of monetary authorities to inflation and unemployment, we studied the responses of interest rates to shocks in those two variables. There is some evidence that interest rates responded more strongly to Portuguese inflation before the financial crisis and more actively to Portuguese unemployment during the crisis, but less strongly to both of the variables in the more recent times.

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